Electrostatic Discharge Induced in Packaging by Space Radiation

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ABSTRACT

A method is developed for estimating the ESD pulses produced by insulated packaging in the space environment. High-energy space radiation, predominantly fast electrons, penetrate into electronic materials and charge insulators. Without sufficient leakage to spacecraft frame, the space-charge fields in the insulators produce occasional spontaneous discharges. Packages may be analyzed as dielectrics with various metallic electrodes attached. Data from spacecraft, and laboratory-based scaling laws are available for the frequency and magnitude of pulses generated in circuit board materials, wiring and thermal blankets. Laboratory data provides indications of the effects produced by the geometry and materials of the dielectric-electrode structure. A preliminary set of scientific guidelines is presented for estimating the variation of worst case pulses that packages may produce as the package designs and materials are varied. The guidelines help one to develop ESD-free packages. Phenomena requiring further study are listed.

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Biography: Dr. A. R. Frederickson.

Dr. Frederickson has 35 years experience in Radiation Transport and Dosimetry, Radiation Effects in Materials, Effects of High Electric Field in Dielectrics, Defect Studies in Semiconductors, and Electromagnetic Measurement Techniques. He has designed and performed experiments to: 1) measure dose and charge deposition in order to improve and verify radiation transport codes, 2) analyze and predict the motion of electrically active point defects in silicon, 3) quantify electrical breakdown in insulators subjected to radiation, 4) quantify charge motion in insulators, and 5) provide design guidelines for spacecraft applications. Prior to joining JPL in 1997, he worked 31 years in the Air Force Laboratories and two years at Rensselaer Polytech. His PhD was earned at University of Mass., Lowell.